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## Creating Tomorrow, Fall 2014

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# CREATING **Tomorrow**

COLLEGE OF ENGINEERING, FALL 2014

[www.engineering.usu.edu](http://www.engineering.usu.edu)



SHAPING UTAH'S FUTURE

**UtahState**University



## *A Note from* Dean Christine Hailey...

# IMPACT: How Engineers are Shaping UTAH'S FUTURE

to provide a social and economic return for the state of Utah as our research discoveries are translated into commercial applications. As a state-funded institution, it is important to acknowledge Utah's investment and realize that the College of Engineering, and its research, play a direct role in the state's forward-moving economy.

This issue of *Creating Tomorrow* features stories of how the College of Engineering is shaping Utah and its future. Whether immediate or long-term, we are actively engaged in projects that are making a difference in all areas of the state. The Department of Mechanical and Aerospace Engineering's Senior Design Program has started to bring in corporate sponsors from all over Utah to sponsor our students and task them with creating a needed product or invention. The experience gives students the opportunity to earn solid resume building and networking experience and, in return, the companies receive solid product design and prototyping. The Sustainable Wastes-to-Bioproducts Engineering Center (SWBEC), initiated in the Biological Engineering Department, has partnered with the international firm WesTech-Inc., located in Salt Lake City, to build the first large-scale prototype of the rotating algae biofilm reactor (RABR), a new technology that facilitates the remediation of contaminated drinking water and wastewater. By employing the use of LandSat, a NASA satellite program, and an unmanned aircraft from USU, called AggieAir, researchers at the Utah Water Research Laboratory are helping Utah farmers grow their crops more efficiently and with greater yields by providing

them with actionable information to make data-based decisions about water management. This is but a sampling of the many stories in the magazine and, as you begin reading, you will find many more examples of how the College of Engineering is creating an impact in Utah.

This fall marks a significant event for the College of Engineering as we work to renew our ABET accreditation. ABET accreditation is a rigorous process that provides assurance that the programs in our college meet the quality standards established by the engineering and computer science professions. I feel our degree programs more than meet those standards and provide our students with the information, support and academic resources needed not only to earn a degree, but to achieve success. And success is critical as it is often the springboard that allows our students to go on and start their own business, work for industry, attend graduate school or follow the path to a career in academia.

As you read through the magazine, I hope you learn new and great things about our students, faculty and alumni. Individually, they are impressive. As a group, they create a force undeniably making an impact around the world.

*Christine E Hailey*

Sincerely,  
Christine E. Hailey  
Dean, College of Engineering

The beginning of a school year is an exciting time on a university campus and is a great time to reflect on the many successes of our students, faculty and alumni. Collectively, their hard work and determination create an incredible impact, not only at the university level, but at a state, national and international level, as well. To that end, this issue of our magazine *Creating Tomorrow* will center on the theme "impact" and will highlight the many activities the College of Engineering is doing to create that impact.

It's been nearly one year since I was appointed dean of the College of Engineering and I take great pride that we stand as a gateway for aspiring engineers and computer scientists. The versatility of an engineering or computer science degree creates endless opportunities, and, I can say, our college is exceptional because of the faculty and researchers who dedicate themselves to helping our students become the highly-skilled influencers of tomorrow. As such, the college provides opportunities for faculty and students to participate in research projects at the forefront of science and technology. Many of the projects go on



## Concrete Canoe Team Places 4th Overall in Nation and Takes Home

### "Best Final Product"

Utah State University's Concrete Canoe Team competed at the American Society of Civil Engineers National Concrete Canoe Competition in summer 2014 placing fourth overall in the nation. The team also received "Best Final Product" for its Promontory Point inspired canoe.

The team, consisting of 20 members, traveled to the event held at the University of Pittsburgh at Johnstown, to compete against 22 universities from around the nation. USU has competed at nationals for four consecutive years. A third place technical paper and fifth place design paper helped the team finish in fourth place overall, topping last year's fifth place finish. The USU canoe featured a three-dimensional railroad track and scenery along the interior of the canoe.

"The high amount of detail in the three-dimensional inlays in our canoe boosted our team to the top of the competition giving us the 'Best Final Product' award," said Nathan Fox, captain of USU's Concrete Canoe Team.

The concrete canoe competition is comprised of four parts: a technical and design paper, an oral presentation, the final product and five races. Teams are only given the opportunity to compete at the national level if they place first at the regional level.

The American Society of Civil Engineers hosts the competition as a way to give future engineers an opportunity to learn project management, design and construction skills. The canoe also has to perform well in the water.

"One of trickiest parts of the competition is that the canoe has to float back to the surface of the water after being completely submerged," said Fox.

The canoe will be on display in the USU Engineering building atrium throughout the 2014-15 school year, as well as at various community events. Those interested in becoming involved in the USU Concrete Canoe may email [usu-concretecanoe@gmail.com](mailto:usu-concretecanoe@gmail.com) or follow the project on Facebook at "USU Concrete Canoe."



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Courtesy of engineering faculty, students and university photographer.

#### ON THE COVER:

Blake Tullis, USU professor of Civil and Environmental Engineering, stands in flowing water at the Lake Isabella Dam model at the Utah Water Research Laboratory showcasing a labyrinth weir spillway design.

#### BACK COVER:

USU Concrete Canoe Team members give a big "Thank You" to all who supported the team as it worked to design and build the award-winning canoe.



Undergraduates Excel in

# Institute of **BIOLOGICAL ENGINEERING**

USU Biological Engineering (BE) undergraduate students are given the opportunity to become part of the Institute of Biological Engineering (IBE), a professional organization that encourages inquiry and interest in the field.

"I'm getting networking opportunities and am able to talk to peers across the nation as an undergrad student representative for IBE," said Ryan Putnam, USU IBE chapter president. "I am able to see first-hand the inner workings of a professional organization and gain insight into how other BE academic programs are run, as well as learn about opportunities in the BE industry."

The international conference, held in Lexington, Kentucky, in March 2014, kicked off with a keynote talk by USU engineering alum Craig Criddle from Stanford University. USU BE students Asif Rahman and Ryan Putnam started the first IBE-student social event, where students from different universities networked with each other. The duo also initiated a new IBE award, the Students Choice Award, at the conference, that was well received by the IBE community.

At the annual conference USU BE students at both the undergraduate and graduate levels represented the university well and received many awards.

## **International Genetically Engineered Machines (iGEM) Competition**

USU BE students won their fifth consecutive gold medal at the North American international Genetically Engineered Machine (iGEM) competition held in Toronto, Canada. USU is one of only four North American teams to have received a gold medal in each of the past five years at iGEM competitions. The team competed against 63 teams from around the world and was judged on its oral presentation, poster and website designed to document its research.

The USU iGEM team's project, "AMPed UP *E.coli*," used synthetic biology to produce antimicrobial peptides (AMPs) in *E. coli*. AMPs are small peptides known for their ability to kill bacteria and are part of the innate immune system of all multicellular organisms. The team designed various expression systems for the production and purification of AMPs. In addition, they designed and purified AMP-spider silk proteins and tested antimicrobial activity of the customized spider silks.

The USU team included five BE undergrad students, one graduate advisor and one high school student. Team participants were Ryan Putman, Andrea Halling, Neal Hengge, Charles Barentine, Tyler Gladwin, Asif Rahman and Kathleen Miller. USU was also represented by Biological Engineering faculty member and team advisor

Charles Miller. Dr. Miller served as a judge for this year's iGEM competition.

"The iGEM competition epitomizes the integration of teaching and research," said Dr. Miller. "iGEM represents one of the foremost events in the field of synthetic biological engineering and is a springboard for producing the field's future leaders."



USU Institute of Biological Engineering students Ryan Putnam, Jonathan Wood, Ryan Hengge, and Yousef Soboh pose with BE faculty member Charles Miller.





USU iGEM competitors pose with the winning poster "AMPed UP *E. coli*." Students (from left to right) are Asif Rahman, Charles Barentine, Neal Hengge, Tyler Gladwin, Andrea Halling and Ryan Putman.



Winning members (from left to right) Asif Rahman, Sean Putman, Jeffrey Moody, Spencer Williams, Siyuan Wang and faculty mentor Charles Miller (3rd from left, back row).

## GRADUATE STUDENT POSTER

### GRAND PRIZE

**Title:** Production of Polyhydroxyalkanoates in *Escherichia Coli* From Alternative Carbon Sources  
**Authors:** Asif Rahman, Ryan J. Putman, Ronald C. Sims, Charles D. Miller, Utah State University

### 3RD PLACE

**Title:** Pathway Pioneer: A Tool for Metabolic Network Visualization and Flux Analysis  
**Authors:** Sumit Kumar Singh, Harsh Dosi, Vipul Oswal, Nicholas S. Flann, H. Scott. Hinton, Synthetic Biomanufacturing Institute, Utah State University

## UNDERGRADUATE POSTER

### 1ST PLACE

**Title:** Production and Purification of Antimicrobial Peptides in *E. coli* Using Synthetic Biology

**Authors:** Ryan J. Putman, Charles Barentine, Neal Hengge, Andrea Halling, Tyler Gladwin, Cody A. Tramp, Asif Rahman, Charles D. Miller, Utah State University; Kathleen M. Miller

### 3RD PLACE

**Title:** Vapor-phase Deposition and Silane Functionality to Address Issues in Silane Capping of ZnO Nanoparticles for use in Neurological Disorder Treatment  
**Authors:** Sean Bedingfield, Kyle Isaacson, Rachael Mansell, Taylor Robins, David W. Britt, Utah State University.

## BIOETHICS ESSAY

### HONORABLE MENTION

**Title:** Helices and Ladders: Impacts on Ethics of the Future Professional world of Biological Engineers  
**Author:** Sean Bedingfield



## Partnership with International Firm Creates Opportunities for BE Department

In 2011, a group of engineers and students in the Sustainable Waste-to-Bioprocess Engineering Center (SWBEC) that was initiated by the Biological Engineering Department and is now administered under the USU Utah Science, Technology and Research (USTAR) program, collaborated on the development of a new technology that facilitates the remediation of contaminated drinking water and wastewaters. The rotating algae biofilm reactor, or RABR, was created as a more sustainable, low-cost and effective water treatment option when compared to more conventional water treatment technologies.

To build the first large-scale prototype of the RABR, SWBEC turned to WesTech-Inc., an international manufacturer of equipment for remediation of drinking water and wastewater located in Salt Lake City, Utah. The prototype, that utilizes the ability of algae that grow as a film on specially designed and configured surfaces, was installed at the Logan City wastewater treatment plant in 2012 to remove phosphorous and nitrogen from contaminated water that would otherwise deteriorate water quality in receiving lakes and streams.

The collaboration was a success. After working with SWBEC from its Salt Lake office for the past three years, WesTech decided to open an office in Logan at USU's Innovation Campus in July 2014. Floyd Griffiths, a WesTech lead process engineer and USU Biological Engineering graduate, moved back to Cache Valley to lead the Logan office with plans to hire additional engineers.

"The partnership of an academic center with industry is unique and provides a path for rapid development, testing and implementation of innovative biotechnologies," said Ron Sims, Biological Engineering Department head.

Besides cleaning the wastewater, the RABR technology provides other opportunities to further its potential and marketability. By using innovative procedures to process the algae, the algae can be transformed into high-value bioproducts, including fish feed, ruminant feed, bioplastics and bio-produced natural gas with high methane content.

Rex Plaizier, president of WesTech, has served on the BE Department Industry Advisory Board (IAB) for six years and served as IAB chair for two years. He has been aware of the development of the RABR and said many of his clients, ranging from municipalities to industry, are potentially interested in implementing the technology.

BESIDES CLEANING THE WASTEWATER, THE RABR TECHNOLOGY PROVIDES OTHER OPPORTUNITIES TO FURTHER ITS POTENTIAL AND MARKETABILITY. BY USING INNOVATIVE PROCEDURES TO PROCESS THE ALGAE, THE ALGAE CAN BE TRANSFORMED INTO HIGH-VALUE BIOPRODUCTS, INCLUDING FISH FEED, RUMINANT FEED, BIOPLASTICS AND BIO-PRODUCED NATURAL GAS WITH HIGH METHANE CONTENT.

And as the RABR technology continues to build momentum, Dr. Sims looks back at the project's initial success and recognizes the role the USTAR initiative played. USTAR funding allowed for the creation of SWBEC that, in turn, created the RABR technology. He also credits former College of Engineering Dean Scott Hinton and the USU Technology Commercialization office that supported SWBEC and encouraged collaboration with industry.

"There are so many benefits of our partnership as it helps to create new jobs and stimulate the Utah economy with new technologies that are both protective of the environment and support industrial development," Dr. Sims said. "It's a win-win situation that puts Utah as a leader in the nation."





# SAIL

Senior, Alumni, & Industry Luncheon

## BE Seniors, Alumni and Industry Celebrate at SAIL-ebration

A group of Biological Engineering faculty, alumni and graduating seniors gathered on the Utah State University campus in late April to celebrate the continuing success and expansion of the department by holding its first Senior, Alumni and Industry Luncheon (SAIL).

The event was organized by the department as a way to congratulate the hardworking seniors graduating with degrees in biological engineering. The department requires a lot of its students just before graduation and wanted to give the students an event that would not only show appreciation to them for all their hard work, but also provide the students an opportunity to meet and network with biological engineering alumni and industry employers.

"The event gave me a unique opportunity to network with those interested in biological engineering," said Sherissa Ward, biological engineering graduate and current biological engineering master's student. "I enjoyed talking to people that saw my degree as valuable, and I was glad that so many alumni attended because it was useful and it was interesting to see where their careers had taken them."

Several USU BE alumni from around the region attended the event and were excited to return to campus, meet with faculty members and reminisce. Industries that were represented were from WesTech Engineering, Bard Access Systems, Quansys Biosciences, ConAgra Foods, Glanbia Food and Sorenson Forensics.

"We wanted our alumni to be able to visit and reconnect with past faculty members as well as meet new faculty members in our department," said Ron Sims, department head for Biological Engineering. "We also provided tours of our new biological engineering

laboratories and facilities and showcased our current research with topics ranging from synthetic biological engineering, biomaterial engineering, micro and nanobiotechnology, bioenergy research and biomedical engineering."

During the luncheon, Rex Plaizier, president of WesTech Engineering, Inc., was presented the Biological Engineering Citizenship Award for 2014. Mr. Plaizier is a long-standing member of department's Biological Engineering Department Industry Advisory Board and is also working with USU's Sustainable Waste-to-Bioprocess Engineering Center (SWBEC) on the rotating algae biofilm reactor (RABR).

"We are a better company because of the USU biological engineering graduates that work for us," said Mr. Plaizier. "Our main offices are located in Salt Lake, but we are opening an office in Logan specifically to work with the biological engineering department's faculty and students and benefit from their research."

The event was such a success that the department plans to continue the tradition every spring.

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AND BENEFIT FROM THEIR  
RESEARCH."

### USU BE PROGRAM 30 ONE OF TOP IN NATION

USU's Biological Engineering Department was ranked 29<sup>th</sup> in the nation in *U.S. News and World Report's* rankings of Biological/Agricultural Engineering Departments for the second year in a row.





Marc Maguire's data collection equipment connected to a decommissioned bridge.

# "JACK OF ALL TRADES"

Marc  
Maguire



Marc Maguire

Marc Maguire knew that he liked math and science at an early age and channeled his skills toward becoming an engineer. The Nebraska native is now an associate professor in Utah State University's Department of Civil and Environmental Engineering and, after only having been here for one year, is making his mark in the structural engineering industry.

The self-professed "jack of all trades" has a wide variety of projects in his care that range from measuring replaced bridge strength to developing methodology for engineers to predict cracking and deflections for concrete panels. Dr. Maguire thinks his broad interests are complementary and benefit each project with which he's involved.

"I consider myself a 'jack of all trades' in the engineering world," he said. "I feel that my variety of experiences will benefit the organizations I work with as well as my graduate students by teaching them a wide variety of problem-solving skills."

Dr. Maguire is currently working on five major projects in addition to his teaching duties. Working with fellow USU Civil Engineering professors Paul Barr and Marv Halling, Dr. Maguire

is testing replaced Utah Department of Transportation (UDOT) bridges in the lab to see just how weak they really are. Surprisingly, lab results show that the structures are not as weak as their appearances might relay and that full replacement may not be necessary. Instead, potentially only riding surface issues may have to be considered.

"Qualifying deterioration will give UDOT an idea about similar bridges in similar shape," he said. "The goal of our research is to provide UDOT with in place 'load and dynamic testing' techniques and will save them money."

Much of the work centers on developing materials and techniques that ultimately save money by using better resources and designs.

Dr. Maguire has a second project with UDOT that involves developing repair concrete for potholes and delamination. The challenge of the research is dealing with two different time-dependent properties, shrinkage and creep. Current repairs tend to be short-term fixes so again, the goal is to provide UDOT with a cost-saving solution that could translate to more available UDOT services.

To the east, Dr. Maguire is helping





the Wyoming Department of Transportation (WYDOT) with bridge quality issues. He is developing predictive models for bridge deterioration in order to give WYDOT a planning tool to direct resources properly.

Dr. Maguire's expertise also includes building better roof systems for commercial scale, one-story buildings. Working with Vulcraft, a division of NUCOR in Brigham City, Dr. Maguire is helping to create a stronger system that prevents buckling of the top cord of prefabricated steel trusses. The new design has the potential to increase the span Vulcraft roof systems, helping them compete with other roof systems, nationally.

A fifth project for Dr. Maguire moves away from roads and bridges and roofs to precast concrete panels. In partnership with the Precast/Prestressed Concrete Institute, he is helping to develop a methodology for engineers to predict cracking and horizontal deflections in precast panels used for commercial scale projects. His technique looks at small component level tests and uses the observed behavior to simulate a full scale component.

Dr. Maguire is elated to be

involved in so many different aspects of structural engineering in his first year at Utah State and plans to stay and enjoy life in Cache Valley for years to come.

"The area is awesome," he said. "I have great relationships with my peers and feel great about what I have to offer as a faculty member."

Along with the organizations he works with, Dr. Maguire is also having a positive impact on the students at USU. He has already hired five graduate and three undergraduate students to work for him as well as recruited a cadre of volunteers looking for new experiences. He looks forward to what his work might accomplish on campus and around the state.

"I really like applied research mainly because it has immediate impact once implemented," said Dr. Maguire. "The real benefit is the satisfaction of knowing that my research is provid-



A dump truck produces real-life conditions for structural strength assessment.



Dr. Maguire oversees concrete preparation for a future stress experiment.

ing a better and sometimes cost saving solution to a multitude of engineering problems."



## Utah's Spring Runoff Serves a Variety of Purposes

Every spring in Utah the winter season's snowfall begins to melt and fill the state's creeks, rivers, reservoirs and lakes. Managing the use of the runoff is a complicated task with everyone from kayakers to ranchers wanting to use the water for different purposes. To help better understand the interdisciplinary nature of Utah's water use, the Utah State University Water Initiative sponsors the annual Spring Runoff Conference for USU students and faculty, as well as state water professionals.

The conference attracts more than 200 attendees, many of whom are students aspiring to be water managers, engineers or hydrologists. Faculty and industry professionals attend, as well, and share research and information about best practices covering a broad range of water-related topics. Past keynote speakers include Brian McNerney, chief hydrologist for the National Weather Service in Salt Lake City, as well as the Colorado River commissioner and the Las Vegas Water District manager.

David Tarboton, professor in Civil and Environmental Engineering and current conference organizer, feels the gathering really helps students understand the complexity of water use and policy in Utah.

"There are many stakeholders with a variety of interests across the state," said Professor Tarboton. "The conference is a great venue, not only for idea exchange, but for illustrating the importance of good water management to students."

Presentations are varied and include topics such as wetlands and habitat around the Great Salt Lake and engineering aspects of groundwater flow. Besides learning from industry experts, the conference also provides a great venue for students to practice their presentation skills and share their research.

Though the conference attendees are mainly from Utah, the event also attracts people from Idaho and other surrounding states looking to gain awareness from the research performed at Utah State.

The conference is organized and supported by the Department of Civil and Environmental Engineering, the Utah Water Research Lab, the Department of Watershed Sciences and the USU Ecology Center.

## Focusing on Our Strengths

The Pile Driving Contractors Association (PDCA) chose Utah State University to implement the Professors' Driven Pile Institute (PDPI) in 2002. The PDCA estimates that since then, more than 15,500 engineering students from across the country have benefited from the instruction provided to approximately 172 professors.

The PDPI is the only workshop of its kind for driven piles and targets young professors who haven't worked outside of academia said Joe Caliendo, USU associate professor in Civil and Environmental Engineering and driving force behind the success of the PDPI.

"Many professors haven't had the chance to see pile driving in the field," said Dr. Caliendo. "This workshop gives them real-world, hands-on experience provided by both academic and industry experts."

Twenty-five professors are selected to travel to the Logan campus for the PDPI every other year. The workshop provides them with the expertise and materials needed to teach undergraduate and graduate students about the world of



PDPI Institute attendees learn best practices for teaching pile driving techniques by taking part in hands-on workshops.



driven piles. The five-day PDPI includes classroom instruction and computer lab exercises for the first few days and concludes with field demonstrations to show how a pile is driven and tested.

In April 2013, the PDCA honored Dr. Caliendo for his efforts with the PDPI by giving him its Presidential Award for Distinguished Service.

"The PDPI is an exceptional and very important PDCA program that would not be possible without Dr. Caliendo's involvement," said Stevan A. Hall, executive director of the PDCA.

For Dr. Caliendo, the highlight of the workshop is introducing visiting professors to the USU campus and local area. The workshop includes a cookout at Spring Hollow Campground in Logan Canyon and a hike on the Crimson Trail, an experience that often wows those who haven't visited the West.

Dr. Caliendo said the PDPI would not be as successful without the help of USU's University Inn, Desert Deep Foundations (formerly Build, Inc.) and the PDCA.

## Graduate Program Climbing Toward the Top

In 2013, Utah State University's civil engineering graduate program rose 32 spots to no. 53 in *U.S. News & World Report's* annual rankings. The graduate program shares the spot with seven other schools, including University of Utah.

Craig Adams, department head for Civil and Environmental Engineering, credits the department's outstanding faculty, high-quality research and relatively low tuition cost for the rise. These factors allow the department to recruit the highest quality graduate students who go on to have successful careers.

"On an individual basis, our faculty members have each developed a strong national reputation for successful and important research that is making an impact, both nationally and internationally," said Dr. Adams.

The department also recently promoted a large group of successful junior faculty, including associate professor David Rosenberg, who received a Faculty Early Career Development 'CAREER' Award from the National Science Foundation. The NSF's top grant program for early career develop-

ment of junior faculty, CAREER Awards are given in recognition of demonstrated excellence in research, teaching and the integration of education and research.

Dr. Adams said the program's rise in rankings may help students in deciding where they want to study, but for the department, it simply recognizes the great program they have had for many years.

"ON AN INDIVIDUAL BASIS, OUR FACULTY MEMBERS HAVE EACH DEVELOPED A STRONG NATIONAL REPUTATION FOR SUCCESSFUL AND IMPORTANT RESEARCH THAT IS MAKING AN IMPACT, BOTH NATIONALLY AND INTERNATIONALLY."

— Craig Adams



# Crowding Out GOOD

Dr. Kyumin Lee is no stand-up comedian but this Utah State University assistant professor in the Computer Science Department knows a thing or two about tough crowds and how to work them.

He joins them. At least long enough to ascertain the negative impact bad crowds can have on the Internet and what can be done to remedy it.

Dr. Lee recently received a Google Award to take on a monumental task of making the Internet world a better, more credible, place by detecting and preventing crowd-sourced manipulation of search engines and online social networks.

In June he and his colleagues, Steve Webb (yes, Webb) with Georgia Institute of Technology and Hancheng Ge from Texas A&M University, presented their research on this topic that was also published in the 8th International Association for the Advancement of Artificial Intelligence Conference on Weblogs and Social Media. His research was also highlighted in June's *MIT Technology Review*.

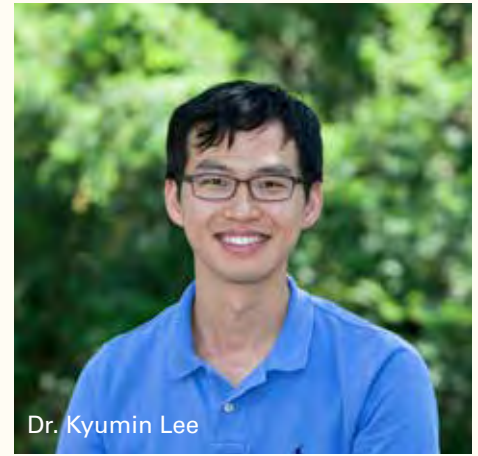
What they unveiled was the first study and model, with an accuracy rate of 97.35 percent, to automatically detect malicious crowdsourcing activity slithering through search engines, online user traffic and social media sites. They've basically developed a virtual vaccination to protect against these spurious activities. It's a powerful tool that ultimately they hope to widely deploy to help protect the Internet's overall integrity.

They began by looking under the rocks of crowdsourcing systems in search of nefarious critters scurrying about. In the process, they uncovered some pretty filthy rich people, including one seller from Moldova who earned at least \$3 million over the past two years through dubious data manipulations of various sorts with the help of a host of workers under him.

In the active and growing world of online marketplaces, tens of thousands of sellers legitimately offer a broad spectrum of services at bargain prices for buyers. For example, on Fiverr, a popular online marketplace for human services, a seller offers to write five snappy taglines for \$5. For the same price, people will sing and record songs, make logos or messages appear out of clay, perform virtual assistant duties and write press releases.

It's good for the sellers and great for the buyers, Dr. Lee says.

With most all the good things that humans create, however, inevitably there is a dark side. Bad things begin to happen when sellers cross the ethics line and offer buyers shady deals such as manipulating a website's Page Rank score or artificially propagating a message through a social network or artificially adding friends to a social networking account.



Dr. Kyumin Lee

That's what happens when sellers engage individual workers to create bogus information that amass into impressively high numbers. This is called crowdturfing. It is a combination of crowdsourcing and astroturfing. While crowdsourcing, such as Fiverr and Amazon's "Mechanical Turk" provide legitimate online marketplaces, astroturfing involves using fake names to do things like post positive or negative reviews.

People in developing countries, where labor is cheap, can make a good living doing this.

"They can earn enough salary while working on this kind of job at home," Dr. Lee says. "One guy in Bangladesh can earn three or four times the salary of the average worker in his country."

Such a person may know it is unethical but he likely justifies it as being fairly harmless, he says.

"When you aggregate this misusing behavior, however, the impact is significant," Dr. Lee says. "These crowdturfing tasks threaten the entire web ecosystem because they degrade the trustworthiness of information. That's why Google and federal agencies are so interested in this problem."

Dr. Lee and his colleagues hypothesized that crowdturfing poses a serious threat but they wanted to determine to what extent such activity actually affects the web ecosystem. To answer that question, they devised a way to measure real-world impact of crowdturfing gigs.

Their case studies brought them directly in contact with some of the unethical sellers peddling their wares. They carefully investigated the top seller's gig (task) descriptions to identify which



gigs they offered and sold to buyers. In their case study, they tested some 87,000 gigs. Of that number, 19,904 were predicted as crowdurfing gigs.

Some of the titles of those gigs: “I will 100+ Canada real Facebook likes just within 1 day for \$5” and “I will send 5,000 USA only traffic to your website/blog for \$5.”

In one of their research approaches, they focused on gigs targeting Twitter. They created five of their own Twitter accounts complete with fake profile photos and one tweet posted to each account. The accounts did not have any followers or follow any other accounts.

For a total of \$25, Dr. Lee and his colleagues engaged five different sellers who promised to send them a combined 43,600 followers. Within two days they amassed 45,000 followers. They then measured the impact of those artificial Twitter followers by using the Klout Score, an online service that measures influence from 1 (lowest influence) to 100 (highest influence).

The initial Klout scores for their five Twitter accounts were all 10. Those scores nearly doubled on almost all five of their fake accounts following the deluge of fictitious followers.

Dr. Lee says this experiment demonstrated that an account’s Klout score correlates with its number of followers, artificial or not. It proved that these manipulations have real-world impact on a real system.

Interestingly, they later checked how many of their new “followers” were suspended by the Twitter safety team two months after they collected them through Fiverr. To their surprise, only 24.6 percent of the 46,176 followers were suspended after two months. It showed that Twitter’s security system is not effectively detecting these fake followers, he says.

Dr. Lee and his team, on the other hand, have demonstrated that it is possible to detect and prevent these activities with astonishing accuracy. It is a system they have developed with the potential to seriously thwart unsavory sellers dead on their feet. No joking around.



## Give Peace (and Bandwidth Space) a Chance

Dr. Ming Li is a man of peace who yearns for coexistence, cooperation and . . . spectrum-sharing among today’s disparate wireless networks.

Is that asking too much?

This Utah State University assistant professor in Computer Science certainly hopes not because he and two graduate students plan to spend a handful of years on the quest. He is a recipient of a five year CAREER grant from the National Science Foundation to basically develop a new way for a diverse array of wireless devices to work together through elaborate interference cancellation techniques and state-of-the-art antenna technology.

Put a bunch of people in one room at the same time speaking in the same frequency and good luck with that. Same thing when dealing with a number of wireless systems competing against each other in limited bandwidth space. And that’s a big problem because all kinds of wireless devices are already out there and growing in numbers, including elaborate wireless sensor devices sending crucial data in service specialty areas ranging from healthcare to military.

It’s a big deal and that is why Professor Li believes his research will have broad impacts on networks that share spectrum resources in ways that’s hard to plan for but not difficult to see looming on the horizon. Future networks in unlicensed bands, for example, that need to be accommodated out of sheer dire importance. Wireless sensors transmitting data monitoring a person’s health or being used to detect landslides and forest fires and to gauge water quality and air pollution. All of these devices are competing for bandwidth while transmitting signals that could, in some cases, mean life or death.

Professor Li has concluded that the current model for wireless transmissions cannot stand up to the demands of the future. The current model for transmitting signals uses an interference-avoidance approach. That is, transmissions are separated in frequency, time and space to enable sharing of the spectrum rather than looking to simply eliminate or reduce the interference.

Why that’s a big deal is because it lowers the quality of the signal, like forcing everybody in the room to speak in whispers. The process of separating transmissions in frequency, time and space is also costly and energy consuming by wasting precious battery power, for example, to get the signals to reach.

There’s got to be a better way, he thinks. Why not instead focus on a better process for devices to actually share the frequencies more efficiently rather than trying to shoulder in on each other at the exclusion of the others?



It's a coexistence, cooperation model that could make you break into a verse of Kum Ba Yah. He sees a new paradigm among diverse multi-hop (signals hopping from one place to another) wireless networks working in tandem. What gives him courage are the recent advances in multi-input multi-output interference cancellation techniques.

His proposed approach allows disparate networks to cooperatively cancel or mitigate their cross-technology interference to enhance everyone's performance. This is where antenna technology comes into play.

While today's WiFi mostly beams out signals in large, sweeping waves, it is possible to target them, rifle fashion, specifically to intended receivers. Instead of scattering a signal to the wind, it can more optimally be used between two devices capable of sending and receiving a signal. This is called beamforming, Professor Li said.

It increases the capacity of wireless channels. In essence, two antennas double channel capacity. It is what routers with multiple antennas can do if both are using the same beamforming technology.

In terms of sharing bandwidth, it would be like little invisible routers above the heads of couples assembled in a large room who are all speaking at once. Despite the signal convergence, each couple would still be able to carry on normal conversations because the competing noise would be cancelled out. No need to build separate rooms for each of them or waste energy on trying to boost volume, or require them to speak in lower voices.

This is possible because they can transmit to each other without interfering with other devices and they can transmit at the same time in the same location and in the same frequency. The great barrier of time, place and frequency would come tumbling down under Professor Li's new paradigm. A significant obstacle will have been removed. Come together now.

It respects differences while sharing the same space. It's what Professor Li is all about. Gandhi, King and Mandela would be proud.



Dr. Christine Hailey advises "App Girls" to keep their options open.

## App Girls Get a Taste of the Future

Something special took place June 12, 2014, at 11:20 a.m. on the fourth floor of Utah State University's College of Engineering. The college's dean, Dr. Christine Hailey, met with a group of young people in a computer science class.

Um, okay, and that's special because . . . ?

Well, Dr. Hailey is the college's first female dean and she's meeting with a group of 11 middle school girls and eight high school mentors participating in the university's first female-only computer science summer camp.

Awesome. But that's significant because . . . ?

Because the dean asks the young women straight off why USU is hosting a female-only computer science summer camp.

"To get more girls involved in computer science" a girl quickly answers.

"And why do we care about that?" Dr. Hailey asks.

"Because there's not that many girls," comes the response.

Bingo. Yah, it is kind of a big deal. Even still in 2014.

It certainly was a motivation for Dr. Hailey to take time with the girls, also known as "App Girls," for the smartphone applications they developed throughout the week. It is also why Dr. Vicki Allan, associate

professor of Computer Science at USU, and Computer Science lecturer Linda DuHadway volunteered their time to team with Andrea Castillo, a recent graduate of Logan High School who also happens to be camp director.

The dean tells the girls about her challenges breaking into a male-dominated mechanical engineering field. She says it felt daunting as a college student to be the only woman in all-male classes. She says it was hard at first because she kept doubting herself.

"I kept asking myself, 'should I be here?' and then I realized that, 'of course I should!,'" she says. "We should all be here."

No excuses, and that goes for the clever ones programmed into "The Excuse Generator" application the App Girls developed earlier that week. Excuses like: "Sorry, I can't find my pineapple," or "Sorry, I'm going to be sick that day unless ice cream is involved."

It is a relaxed environment for the girls to try on new things, to push themselves to think in different ways and to see for themselves how much they really do belong in the world of engineering if they so choose.

And choice is the operative word. Keep the doors open, the dean counsels the girls.

Take as much math as you can now, she says. And even if you choose

not to become an engineer, at least you know you had the option to go into fields such as computer science, civil engineering, biology, physics or business.

"It opens many more doors to you," she says. "Don't close those doors until you can at least walk through them a little bit."

Dr. Allan attests to that. She was fortunate to have her father, Dr. Rex L. Hurst, nudge her along when he was department head of the USU Applied Statistics Department some 30 years ago. When she couldn't get the classes she wanted at USU, her father always helped her fill in the blank blocks on her class schedule with computer science courses. She eventually graduated in math education with a minor in computer science.

It opened doors for her that typically were not readily accessible to women in the early 1970s. While the door shut on her early plans to teach high school mathematics, several more doors opened to her that eventually led her to a productive and satisfying college teaching career.

So while Dean Hailey, Dr. Allan, DuHadway and even the young Castillo each have stories about what led them to where they are today, each have someone in their lives who helped them along the way. They were not people who lectured them; they were people who influenced them.

Anyone present June 12 at 11:20 a.m. on the fourth floor of the engineering building would have been impressed by the attentiveness of these young women as they listened and interacted with the dean and her colleagues talking about the smartphone applications developed that week and about their futures.

Wheels were turning. The App Girls were engaged, respectful and responsive. They were with peers of their own gender, smart, sassy, adorable, in the company of impressive women who, without having to vocalize a thing about their own achievements, said everything to these young women. No app could do that.

## Bringing Chic to Geek: USU Computer Camp Helps Girls Cross the Digital Divide

They were not a band or a movie, but the App Girls were most definitely a band of middle school girls on the move with smartphones in hand as part of a week-long summer camp at Utah State University.

The 11 girls, along with their eight high school mentors, developed their own smartphone applications — and some new-found aplomb along the way.

A computer science camp for girls may sound geeky and maybe daunting to the uninitiated, but Dr. Vicki Allan, associate professor of computer science at USU, kept her promise of no hard coding, no hard math and no boys (no hard feelings, guys). Just an open setting for girls to realize their inner digital side.

Like summer camps are meant to be, this camp was fun and engaging. It was a starting point; a chance for young women to dip their toes in the world of computer science. Ironically, while computers permeate nearly every aspect of daily life, computer science, as a profession, is largely overlooked by women; a phenomenon more common to the United States.

Dr. Allan hopes camps like this will help to change that, to show girls all the options a career in computer science offers. For those who want to combine career and family, it is one of the rare occupations where women, in many instances, can elect to remain home and choose their own hours, she said.

"It is an amazingly flexible field for young women," Dr. Allan says. "Jobs are dynamic and exciting. Salaries are excellent. Job opportunities are plentiful."

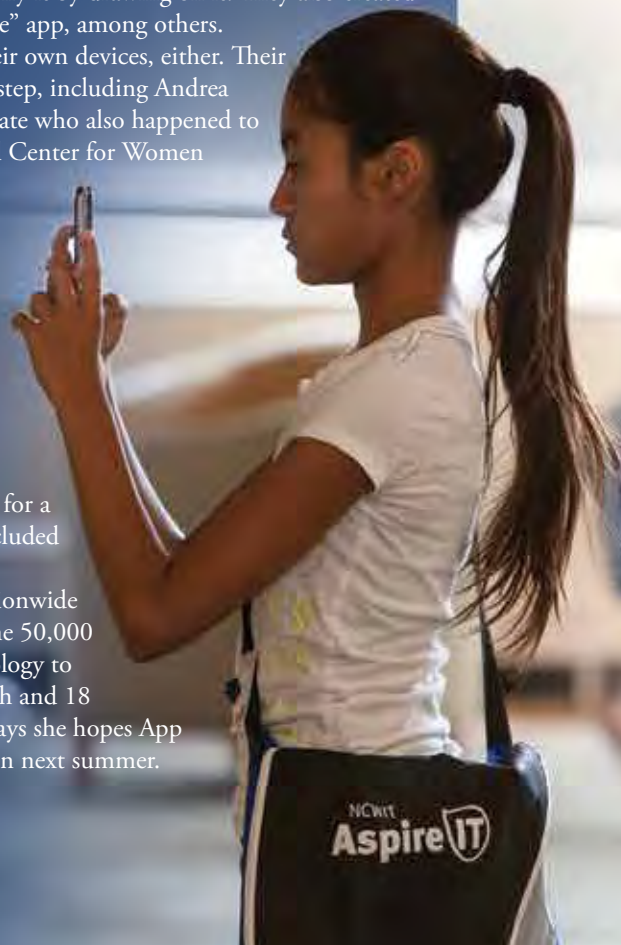
The USU camp was interactive with plenty of activities to gently introduce participants to the world of problem solving and programming. It proved to be a compelling week for these young women because they experienced computing in a different way — from that of users to actual developers, she says.

They created six different applications during the week including one that allows a user to take a photo of an object and modify it by drawing on it. They also created a USU Walking Tour app and a "Talk to Me" app, among others.

And none of them were ever left to their own devices, either. Their near-peer mentors were at their sides every step, including Andrea Castillo, a recent Logan High School graduate who also happened to be camp director. She was a recent National Center for Women and Information Technology (NCWIT) Aspirations in Computing award winner for Utah. NCWIT sponsors both the Aspirations award and the AspireIT program, a technology outreach program for girls at middle school level supported by Intel, Northrop Grumman and Google.

Dr. Allan and USU colleague Linda DuHadway volunteered their time to team with Castillo designing the curriculum and hosting the camp at USU. It was held daily for a week in June from 9 a.m. to 1 p.m. that included lunch each day.

App Girls was one of 46 programs nationwide to receive a NCWIT grant. It provided some 50,000 instruction-hours in computing and technology to more than 1,300 middle school girls in Utah and 18 other states. If funding permits, Dr. Allan says she hopes App Girls will be on the move at USU once again next summer.





**The USU Concrete Canoe Team** poses with the canoe that placed 4th overall in the nation and gave it “Best Final Product.” Team members spent more than 35,000 hours designing, building and preparing for the competition. The team studied various hull designs and tested more than 30 different concrete mixes before building a full-size practice canoe early on in the school year. Once the practice canoe was created, the team went on to experiment with several casting and finishing methods before it came up with the winning formula.







PROMONTORY



Dennis Briscoe



Mel Torrie



Jim Nottingham

## *The Business of Engineering* — Cache Valley

When a student graduates with a degree in electrical and computer engineering from Utah State University there are multiple career options. With an employment rate of nearly 100 percent, the new graduates enter the workforce to realize a quick return on their educational investment. Some go to labs in the private or defense areas. Some enter the business world and some establish their own firms. Here are three alumni making a mark in business and the corporate worlds.

Today, a firm with solid roots in Cache Valley and a close connection to Utah State University isn't what it started out to be. Logan Electronic Products Company (LEPCO) began conducting research and measuring radiation in the upper atmosphere for the Department of Defense during the heady early days of the aerospace industry in the mid-1960s. Then, with a shift in the defense and political climate in the country, the company transitioned and began creating instruments to measure soil moisture. Another transformation took the company into the world of medical and laboratory equipment as Wescor, Inc. in 1970. And through it all, there remained a strong commitment to Cache Valley. The company was founded and directed for more than 40 years by Wayne Barlow, a USU engineering faculty member.

When Wescor merged with its distribution partner in Paris, France, in 2007, the resulting worldwide medical diagnostic company became known as ELITech Group, with an objective to offer Elite Technology to medical laboratories of all sizes throughout the world. At the core of ELITechGroup's Biomedical Systems operation in Logan, Utah, is laboratory equipment, including hematology and microbiology stainers, osmometers and sweat testing equipment to diagnose cystic fibrosis.

ELITech Biomedical Systems division is now headed by Dennis Briscoe, a USU alum and strong advocate for its engineering program. He joined Wescor in 1994 as the director of engineering. He was vice president and on the board of directors when Wescor began looking at financial offers that would be attractive to the company's founders but also allow it to remain an anchor in Cache Valley. It was at a 2005 medical exhibition in Europe that Briscoe first discussed an acquisition of Wescor with ELITech management, and in 2007 Wescor officially became a part of the ELITech Group. At that time its annual sales figures were in the \$14 million range. Today, seven years later, those figures are at \$26 million of the ELITech Group's \$150 million. The company is doing well and sees sales increases of 5-10 percent a year.

Since it is still based in Cache Valley, the company not only contributes to the local economy but it generates jobs, from entry level to engineering management

positions. There are now close to 100 employees at the Logan facility.

Briscoe earned an undergraduate engineering degree from USU in 1981 and wanted to follow a career path that used engineering and science to "solve problems that exist in the real world," he said, and finds working in the medical device field to be "extremely rewarding." He points to one of the firm's sweat testing devices — the "Macroduct" that leads the world in the laboratory diagnosis of cystic fibrosis.

Briscoe said the solid foundation in engineering fundamentals, dedicated professors and experience in applications of embedded systems contributed to his career success. He said he was happy he chose USU for his education and has never been disappointed. He now serves on the ECE Department Industry Advisory Committee. ELITechGroup supports current students in employment opportunities and offers an annual scholarship to USU engineering students. He endorses the department's — and the college's — emphasis on hands-on work and the ongoing efforts to keep programs relevant and up-to-date with current technology.



Jim Nottingham's path to an engineering career with a leading corporation in the computer world wasn't direct — in fact,





# and BEYOND

it might be attributed to football and donuts. In many ways, Nottingham's experience mirrors current students who study with the pressure of family and work. He was married at a young age — during his high school years, in fact. When he arrived at USU in the late 1980s, it was to check out the football team because he wanted to play. During a tour of campus he ended up in the engineering building and learned that if he took an aptitude test, there would be free donuts at the conclusion. He was sold! Following the donut reward he returned home to work construction. During that summer he received a letter saying he had done well on the test and was accepted in the engineering program at Utah State. It was then he met Kathy Bayn, who still advises engineering students today, and she convinced him that it was “doable.”

“She made me feel welcome and it felt like I belonged,” Nottingham said. “She laid it all out and I decided I wanted to go to school.”

A month later Nottingham and his wife, Sherry, had moved to Logan and at first the transition to school was difficult. After several weeks Nottingham said he wondered what he was doing; he was stressed about grades; but then he had a transformative moment when the proverb that hung in

the library spoke to him — “And with all thy getting, get understanding.”

After that, things got better and he stopped worrying about grades. He worked —worked his butt off— he said. Sherry worked and he worked nights. By the time he finished his master's degree, also at USU, there were three children. He first earned a bachelor's degree in 1990 followed by his master's in 1992.

“I will forever be thankful for Sherry because she worked as hard as I did,” Jim said. “I look back now and feel very lucky. I had full access to world-class professors. We could talk to them every day, and I did. I had amazing professors in all areas. Yes, we learned ‘theory’ from the books and in the classroom, but a huge element of my education was the hands-on, the practical. There is an element of ‘art’ in engineering and you don't get the art without the experience. When I began my education I didn't consider myself a college kid, but I came to Utah State and felt like I belonged. I received a phenomenal education that got me a great job.”

And that great job? Jim is with Hewlett Packard where he is based in Boise, Idaho. He is vice president/general manager of HP's LaserJet Products & Quality organization. He

calls the engineering program at USU a “diamond in the rough” and readily acknowledges his bullish opinions of the program.

“During my time in industry I've hired many engineers from across the United States,” he said. “Most of the best have come from USU.”



With a grand view, one couldn't ask much more of working for Autonomous Solutions Inc., another firm based in Cache Valley and headed by Aggie alumnus Mel Torrie. Tucked away on 100 acres, one vantage provides an impressive view of the Wellsville Mountains. Look the opposite direction and you can see a vista of Cache Valley's farms and wetlands spread before you. In the distance sits the city of Logan and its iconic landmarks, including the LDS Temple and Old Main's tower. Not a bad fringe benefit for the company's 80 and growing employees. But there's a lot more going on at the firm than just the benefits of a beautiful view. There's robotics in them-thar hills!

The company's mission statement sums it up nicely: “To help organizations reach their potential through innovative robotic solutions.”

And what does that mean to the non-engineering community? The company provides “the highest quality



of unmanned systems to our partners.” Or in other words, the company develops components that install easily in most vehicle platforms to improve operational safety and productivity. Simply stated — unmanned vehicles.

Since the company was founded by Torrie in 2000, there has been substantial progress. Following work in labs on campus, Autonomous Solutions was launched with work taking place in Torrie’s garage on a first contract for John Deere. With constant growth, the firm moved to its current location and is about to expand again. ASI now creates automated or robotic systems for farming, mining, safety and automotive applications.

Torrie earned both bachelor’s and master’s degrees in electrical engineering at Utah State and gives back by serving on both the college and ECE department advisory boards. A native of Alberta, Canada, he was a transfer student from Ricks College and was drawn to engineering because an advisor told him to “do something you love” and he said he loved his toys and is a self-confessed lover of taking things apart.

At USU three professors especially influenced the direction of his study, Dr. Paul Wheeler, Dr. Jan Sojka, who coordinated a number of Get Away Special (GAS) projects that Torrie took part in, and, after seeing a motorized wheelchair driving down a hallway, he was directed to Dr. Bob Gunderson’s lab where he developed an affinity for robotics that turned into a career.

Autonomous Solutions has an international reach with clients spread around the globe. Close to home, the firm’s expertise has been called upon with the ongoing work at Rio Tinto’s Kennecott Mine, where automated applications have been added to the shovels that are clearing the slide area at the mine. ASI is also working with the automotive industry, developing software for driverless operation. Yes, the Google car concept will be a reality — most likely within a 10-year window, Torrie said.

## Student Projects —Hover Craft, a GOAT and Why am I being Followed by a Shopping Cart?

Two things were brought up over and over again by the successful alumni featured here — top-notch professors and hands-on experience.

“When I was hired at Hewlett Packard I was able to jump right in and contribute because I was so well prepared,” Jim Nottingham said. “The fundamentals were there and everything builds from the fundamentals. Sure, we learned the theory in the classroom, but it was the hands-on experience that drove those lessons home. I was so fortunate that Utah State was in my path. ”

Here’s a look at just a few of the hands-on learning projects completed by students in the Department of Electrical and Computer Engineering, many initiated by the students as their senior projects.

### GRASS OPTIMIZING AUTOMATED TRACTOR — GOAT

GOAT is a fully autonomous robot lawn mower that is based on both an Arduino Due and a Raspberry Pi micro controller. Using these controllers the students incorporated two driving modes.

“You can either take the wheel and steer from the comfort of your recliner or let it go by itself while you take a nap or accomplish another task,” the students wrote in their summary.

### MRV — MULTI-ROTOR AERIAL VEHICLE

The MRV platform is a test vehicle designed to implement and verify various control algorithms. The system allows the user to test the functionality of their algorithms in a physical system. The students designed and tested various custom control algorithms on the platform. A motor test bench was developed that allows the user to view current draw and thrust data in response to step, ramp or other command inputs from a stop or about an operating point.

Quadcopters are quickly becoming significant in many areas of research as well as in emergency and service industries. The flying vehicles are being used in military operations, search and rescue, land surveying and aerial photography. The intent of the USU student team is to continue developing the MRV as an educational test-bench for flight control theory, power management and systems modeling. The motor thrust test-bench will be further developed into a marketable product aimed at the hobbyist radio controlled airplane and helicopter industries.

### THE AUTONOMOUS SHOPPING CART (ASC)

The ASC is a motorized shopping cart that can track a shopper. The ASC is able to autonomously follow the shopper around the store while avoiding other people and objects in its path to create a safer shopping environment. The students’ design improves the standard shopping cart by allowing users to walk through the store hands-free and adds convenient features like price checking in addition to cart safety measures.

### MIMICKING ROBOTIC BACKHOE

With often dangerous conditions where heavy equipment operates, this student project explores controlling a mechanical system remotely. The project demonstrated a solution by implementing a small robotic backhoe controlled by a similar arm from a distance. It also incorporated a buck converter to power the robotic backhoe.

The student project concluded that remote controlled mechanical equipment can be applied in a variety of fields, including excavation, remote surgery and animatronics.

# Electric Bicycles and the Electric Vehicles Design Lab

As a new faculty member at Utah State University, Dr. Zeljko Pantic joined the faculty in 2013 as an assistant professor in the Department of Electrical and Computer Engineering after completing his doctorate in electrical engineering at North Carolina State University. Since the title of his dissertation was “Inductive Power Transfer Systems for Charging of Electric Vehicles,” it was natural that he would join Dr. Regan Zane (see last year’s engineering magazine) in work at the USU Power Electronics Lab.

The USU Power Electronics Lab was founded in 2012 by Dr. Zane and is part of a long-term Utah State Technology and Research (USTAR) and campus initiative to build world-class research centers in energy and power. Research challenges addressed by the power lab span a wide range of topics with direct impact to society and the state of Utah, including improving the efficiency, reducing the weight

and extending the lifetime and range of electric vehicles through battery management and much more.

In spring 2014, Dr. Pantic brought the Electric Vehicle Design Lab course to life. The course was a hands-on, design-oriented introduction to the analysis, design, modeling and testing of power electronics systems in the context of a real electric vehicle system. Through practical laboratory experiments students were guided through the fabrication of multiple switch-mode power converters as well as associated analog and digital control systems necessary to realize a functioning, sub-kW electric vehicle. Specific systems include a bidirectional DC-DC converter and motor drive inverter which were designed using standard power electronics analysis techniques. The course culminated with a design exposition and finally a race between the electrically-powered bicycles designed by the students.


The course included eight students — both undergraduates and graduate — who were placed in three teams. Each team built an electric bicycle. The bike frames and all components were off-the-shelf and while the teams’ approaches varied, all were able to build an operating bicycle. In addition to an extensive technical report, each team created a video presentation at the conclusion to describe the process, followed by the concluding “shakedown” race to demonstrate reliability, with a speed “winner” crowned. But, “we all won,” said one student from the class. “We learned an incredible amount.”

“All the teams did exceptionally well,” Dr. Pantic said. “This was a very realistic situation and an extension of Dr. Zane’s fall control algorithms course that offered the theory that was put into practice.”



Students from two of the three electric bike teams provided a demonstration and descriptions of their completed bikes. Representing the teams were Thomas Ameley (left) and Jacob Vanfleet (right).





# Hosting Tomorrow's **TEACHERS** and Engineering **EDUCATION** **RESEARCHERS**

The Utah State University Engineering Education Department was host to a group of eight undergraduate science, technology, engineering and mathematics (STEM) students from eight institutions ranging from community colleges to research universities. The students were part of a competitive Summer Research Experience for Undergraduates (REU) Site Program on Engineering Education Research sponsored by the National Science Foundation.

The 10-week program provided students with intensive experience in engineering education research, such as how a learner's experience, background and perception play a role when they learn engineering knowledge and skills.

"This is a wonderful opportunity for students to not only conduct undergraduate research, but to learn about how students conduct undergraduate research," said Oenardi Lawanto, engineering education associate professor and co-director of the USU REU program. "The program benefits the overall idea of undergraduate research as these students will know how to better incorporate undergraduate research when they begin their own careers at the head of the classroom or in a research lab."

The central focus of the program looked at self-regulated learning (SRL). Dr. Lawanto said that when confronted with a problem or task, a learner usually begins with generating thoughts, feelings and actions to attain the best solution to that problem. Those self-generated thoughts, feelings and actions are called self-regulated learning. Numerous studies suggest that SRL is a significant predictor of a learner's academic performance.

During the program the students worked with faculty mentors and engineering education graduate students on emerging research projects that focused on self-regulated learning in engineering education. The students also participated in workshops, a research symposium and a variety of social and recreational activities. The students spent nine weeks on the USU campus and then went home to their own university to conduct a subsequent one-week at-home activity with research assignments.

REU participant Katie Spendlow, from Colorado State University, applied for the program because she wants to become a teacher and is interested in learning as much as she can about qualitative research. She plans to continue her education and said that

her participation in the program will make her graduate school application incredibly marketable.

Other students in the REU program echoed Katie's sentiments and said participation in the program will open many doors.

"This experience will not only help me in the classroom when I become a teacher, but it also will help me as I pursue further educational opportunities," said Cory Ortiz, an undergraduate from USU and REU participant. "I will be able to participate in more research projects and will be given the chance to present and attend research conferences thanks, in large part, to the REU program."

The program has also made the students realize how many options are available to them as they further their education.

"I have always wanted to teach at an elementary school level," said REU participant Deborah Donaldson, an electrical and computer engineering student from California Baptist University. "However, I worked on a project geared for high school students during my REU experience and I am trying to figure out how I can apply it as I go on in my career."

Siham El Mali, a computer

engineering major from Johns Hopkins University, said the REU experience opened up a whole new world for her.

"I didn't even know it was possible to earn a degree in engineering education," she said.

A lot of students around the country have never heard of engineering education either. It's a fairly new discipline in just the last 15 years, and USU's engineering education degree is currently offered only on a doctorate level and is one of only three such programs in the country. But the awareness is changing.

More than 76 students from 43

institutions applied to be a part of the USU REU program on engineering education research, and faculty members in USU's Engineering Education Department are excited about the future of the field.

"We look at every REU applicant as a potential candidate for our doctoral program in engineering education," said Ning Fang, engineering education professor and co-director of the USU REU program. "The more awareness of our program, the more competitive we become and the further our program can grow."

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Undergraduate students from all over the United States spent nine weeks on the Utah State University campus this summer as part of the competitive Summer Research Experience for Undergraduates (REU) Site on Engineering Education Research sponsored by the National Science Foundation. Visiting students were, front row (from left to right): Bao Pham, Katie Spendlow and David Reeping, and, back row (from left to right): Alex Abate, Cory Ortiz, Siham Elmali, Molly Herman and Deborah Donaldson.







Ben Call

## Encouraging Innovation

Utah State University Engineering Education doctoral student Ben Call wants to improve the way engineering is taught. His doctoral studies focus on the idea that students who participate in hands-on projects, along with the traditional theory studies, are more successful in school and in their future careers.

And he must be on to something as Ben, along with his ideas, was recently awarded a USU Presidential Doctoral Research Fellowship. The four-year, \$20,000 fellowship is given to the university's most elite students, with only one recipient from each research-intensive college or school. Ben is the first Presidential Fellowship Recipient from the Engineering Education Department. As such, he will be given unmatched access to USU resources and assistance ranging from intensive grant-writing workshops to special training at the annual national Graduate Research Symposium.

After earning a bachelor's and master's from USU in mechanical and aerospace engineering, Ben went on to work as a mechanical engineer at Naval Air Warfare Center Weapons Division. During his time with the organization Ben soon realized that a lot of new hires were very good at the basic theories of engineering, but that they lacked skills when it came time to apply it as part of a team.

"As students, we do a lot of quantitative work when we go through an engineering program," Ben said. "If we can figure out how to incorporate more class projects into an engineering program, it will help teach the more qualitative skills of engineering."

Returning to the USU campus in early 2013 for a visit, Ben stumbled upon the David G. Sant Engineering Innovation Building, a building that was not there during his undergraduate days. He later learned more about the Engineering Education Department on its website, was inspired, and decided it was time for a change. After meeting in fall 2013 with Wade Goodridge, an assistant professor of engineering education, and with the support of his wife and three young children, Ben applied for an assistantship in engineering education at USU.

"The Engineering Education program at USU is unique because it allows a student to learn the educational psychology needed to research and address a growing area that straddles both education and engineering," said Dr. Goodridge. "Engineering education is a rapidly growing field that is trying to address many of the typical STEM education issues present both nationally and internationally. I am delighted that Ben has become a member of my research team and I feel that his forward thinking will be an asset to our department and the field of engineering education."

After spending several years working in the field as a mechanical engineer, Ben said the trajectory to becoming a doctoral student focused on engineering education was a natural one.

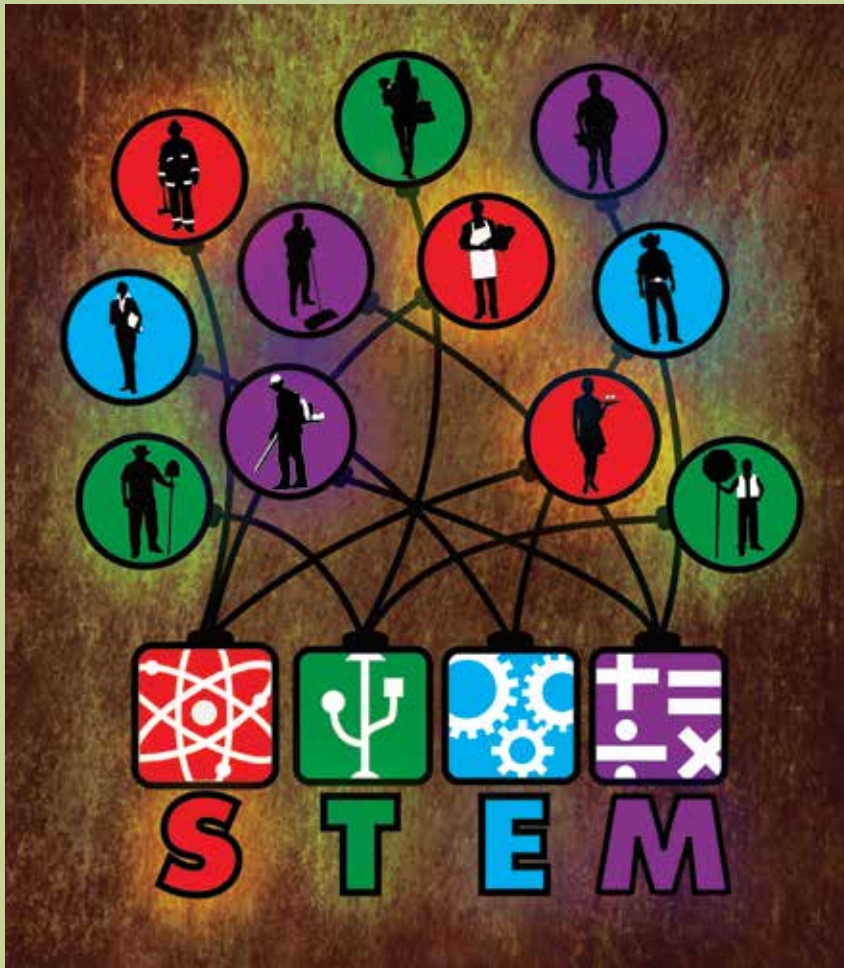
"I have always been interested in education and I have several educators in my family," Ben said. "I was always reading articles pertaining to education and have kept tabs on what is going on with the educational system in the United State and around the world."

Part of Ben's doctoral studies will be to focus on how people learn and then come up with ways to help them better understand or grasp certain concepts. He wants to help engineering students become more successful and he thinks that creativity and entrepreneurial spirit go a long way in inspiring students.

"We need to encourage innovation and give students the skillset to solve problems in unique and interesting ways," Ben said.

Ben believes that by encouraging innovation more students will be excited about pursuing careers in engineering. And that, Ben said, is really the ultimate goal.

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## Plugging in to Education's Future

In today's world, modern technology and its many personal applications are increasingly becoming part of daily life. As devices such as cell phones and laptop computers become smaller and more affordable, people around the world are relying on these items to help get them through their day. For all of these advances, though, the century ahead poses challenges as there is a growing need for science, technology, engineering and mathematics (STEM) careers that develop these modern technologies. How we educate those in STEM programs will affect this need.

"We are in an anytime, anyplace world," said Kurt Becker, professor of engineering education. "Technology is changing the way students' thought processes work and we need to make changes in education in order to keep up with them and to be competitive."

The anytime, anyplace mantra has spurred the Engineering Education Department to develop a stronger online education presence in the College of Engineering to meet the needs of students and increase retention and recruitment efforts. The department already offers several engineering education online courses, and is working to create an entire online library of courses for the pre-engineering program.

Dr. Becker said with the increased need for STEM education, students nationwide are requesting more options for online engineering degrees.

"For lots of people, coming to a traditional campus is not an option," Dr. Becker said. "So whether a student is in rural Utah, or even in Logan and holding

down a full-time job or raising a family, the opportunity for that student to earn an engineering degree when it is convenient for them is an invaluable service."

The Engineering Education Department has dedicated itself to the effort of providing online education as all six professors in the department are charged with developing online courses, as well as faculty located at

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several of USU's regional campuses. The group is working to standardize all courses in the program so they all have the same look and feel.

"We are getting great feedback from our students regarding our current online offerings," Dr. Becker said. "They like that the classes are available to them wherever and whenever they want and they like that they can replay lectures or look at slides when they study. We are looking toward Utah's future by providing a high-quality education delivered in a manner that meets the students' needs."





USU student Amberly Snyder (sitting in wheelchair) with the USU Team ParaMOUNT that created a lift that allows Amberly to get on and off her horse without assistance. ParaMOUNT team members include (from left to right): Jacob Cable, Nathaniel Scheelke, Tayva Lam, Tucker Smith, Joel Hendrickson, Justin Hoffman, Thomas Anderson and Bailey Swanson.

# A ParaMOUNT Success —

## MAE Students Help Fellow USU Student and Paraplegic Continue her Dream of Horse Riding

Utah State University student Amberly Snyder is an avid horse barrel racer who was involved in a car accident in 2010 that left her paralyzed from the waist down. Her independence and desire to continue to ride horses led her to look for a way to get on and off of her horse without assistance. And then, because of a group of mechanical and aerospace engineering students, what once seemed like an insurmountable task, suddenly became possible. Team ParaMOUNT was formed as part of the Senior Design Program in fall 2013 to design a safe and efficient lift system that would help Amberly independently mount and dismount her horse.

"I was excited to work on this project because it gave me the opportunity to help someone," said Justin Hoffman, ParaMOUNT team leader and 2014 MAE graduate. "Amberly wanted the freedom to be able to get on her horse and we were up for the challenge."

And challenge it was. The device had to incorporate several strict design elements, including being able to attach to a horse trailer while conforming to local traffic safety laws, as well as meeting American Disability Association requirements. Amberly,

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—Bailey Swanson

herself, had a list of device requirements that she wanted incorporated, such as having it be mobile and being able to mount her horse from the left side.

“Getting the device to do everything Amberly wanted and work with all the restrictions and safety requirements was the hardest part of the task,” Justin said. “The project forced us to do our best and come up with a solution for her, even with all of the restrictions.”

Throughout the year, Justin worked closely with MAE teammates Thomas Anderson, Jacob Cable, Joel Hendrickson, Tayva Lamb, Nathaniel Scheelke, Tucker Smith and Bailey Swanson to create a device that would consist of four major subsystems, including a wheelchair lift; horse restraints; trailer stabilization; and controls.

ParaMOUNT team member Bailey Swanson (see Senior Design Story) said the project was a team effort that helped the group see the applicability of its undergraduate education.

“That motivation of having to come up with something better for Amberly was a great reminder of why I wanted to study engineering in the first place,” Bailey said.

And the team’s hard work paid off. In the end, the ParaMOUNT device did provide the results that Amberly was looking for.

“I feel the most free when I am on my horse because the horse becomes my legs,” Amberly said. “I get to leave my wheelchair at the trailer and that whole part of my life gets put on hold.”

## 1. DESIGN OVERVIEW

**Wheelchair Lift** — The lift offers vertical and horizontal motion driven along tracks by hydraulic cylinders. The platform integrates restraint straps and a handle to ensure safe operation. A winch folds the lift system into storage mode.

**Horse Restraints** — Telescoping arms fold out from the trailer wall to provide a stall to restrain the horse during system operation.

**Trailer Stabilization** — A subsystem is installed near the axle of the trailer. Motorized jacks are employed to ensure stability and to keep the trailer level.

**Controls** — All motion is governed by a programmable logic controller. A handheld operator box controls vertical/horizontal motion and an emergency stop. A control panel on the trailer also provides operation of these motions as well as trailer stabilization and system storage deployment.

## 2. DESIGN REQUIREMENTS

The device was required to incorporate the following:

- Have a lifting capacity of 260 pounds
- Attach to a horse trailer and conform to traffic safety laws
- Be powered by DC
- Provide comfortable speed and smooth operation
- Allow for independent operation and use simple controls
- Be able to lift a rider on a seat or wheelchair
- Provide safety restraints
- Meet ADA requirements (safety factor of 5)
- Operate with low noise (less than 80 decibels)
- Allow rider to mount a horse up to a height of 44 inches
- Provide restraint for the horse
- Allow the rider to mount a horse from the left side
- Be durable and able to withstand outdoor environments

## 3. TEST RESULTS:

The device successfully met all of the design requirements. Testing and analysis revealed the following performance factors:

- Lifting capacity exceeds 260 pounds (tested up to 400 pounds)
- Collapses to a width of 5.95 inches for storage and travel
- Platform reaches a maximum height of 48.5 inches
- Platform extends and retracts 15 inches horizontally for added mobility
- Accelerates at less than 1 g
- Operates on an average level of 72 decibels







## MAE Students Earn High Honors for 3rd Straight Year in U.S. Air Force Design Challenge

Utah State University Mechanical and Aerospace Engineering students took second place at the 2014 U.S. Air Force Research Laboratory (AFRL) University Design Challenge in April 2014. This was the third year for the competition that includes design teams from 16 universities from throughout the country. Each year AFRL selects a different real world challenge in its effort to help the U.S. Air Force solve critical problems.

The challenge this year was to design and develop a portable, lightweight system that would be able to lift downed aircraft and armored vehicles weighing up to 55,000 pounds from uneven, sloping shale terrain to aid in extrication of wounded personnel in a rescue situation. Furthermore, the system must be able to fit in a backpack and, when deployed, lift up a minimum height of 20 inches. It had to be set up and deployed by one person on any terrain and on slopes up to 50 degrees.

This year's achievement marked the third consecutive award for USU students from the AFRL Design Challenge. Aggie engineers took home first place prizes following the two previous AFRL design challenges to get four airmen up a 90 foot wall without a grappling hook, and a portable bridge that can transverse a 20-foot gap while supporting a 350-pound load.

Top photo: USU AFRL Design Challenge Team, from left to right: Daniel Magda, Nick Fluehe, Carson Holden, Alex Bernkopf, Hiram Knapp, Landan Nielsen, Philip Le Goubin, Dallen Webb, Chase Crandall, Alex Landon, Nathan Hawkes, Andrew Gerber, Logan Williams, Roger Thorpe, Derek Shelley, Kyle Mattinson, Ryan Clawson, Marcus Ritter, Byard Wood, Chris Donohue, Trevor Christensen and Jacob Singleton.

Middle photo: USU MAE students designed a portable, lightweight system that would be able to lift downed aircraft and armored vehicles weighing up to 55,000 pounds from uneven, sloping shale terrain to aid in extrication of wounded personnel in a rescue situation.

Bottom image: A rendition of the jack assembly designed by MAE students as part of the AFRL Design Challenge. Team members designed all components of the compact lifting device that was designed to fit in a backpack and, when deployed, lift up a minimum height of 20 inches.





## MAE Senior Design Program Challenges Students

Seasoned mechanical engineers are involved with challenging projects during the course of their careers. However, in Utah State University's Department of Mechanical and Aerospace Engineering, it's the undergraduate students who work on such high-level projects.

Whether designing a lift system to assist a paraplegic person onto a horse or creating a viable, cost-effective alternative for a peristaltic pump, all students must participate in the Senior Design Program where they are tasked with working alongside fellow students on a variety of design projects.

The program runs through two semesters — the first for the design phase of the project and the second for the build phase. Historically, the projects have been primarily funded internally by USU or by federal grants. The department is beginning to change that model by bringing in corporate sponsors from all over the state of Utah. The corporate sponsors task the Senior Design Program students with creating a needed product or invention. Once the creation is finalized, the company is able to keep all intellectual and production rights.

"The students jump at the opportunity to work with local companies and the companies are benefitting from our student designs — it's a win-win situation," said Dixon Nielson, research development director for MAE. "The students earn solid resume building and networking experience and, in return, the companies receive solid product design and prototyping."

The intent of the Senior Design Program is to put the students in a situation where they have to use the skills they have learned in the MAE program. They are given a challenging assignment with a short timeline and are mentored every step of the way. The MAE faculty assist the students and provide feedback as the projects progress. Weekly lectures

are given that cover topics ranging from manufacturing to business plans. Design and analysis reviews are held throughout the year where faculty and peer students are able to provide feedback.

"Many of the classes necessary to earn a mechanical engineering degree are theoretical," said Bailey Swanson, a 2014 MAE graduate who works as an aviation programs engineer for Garmin International in Kansas. "Having a senior design class where we were able to apply the theory we learned gave me the opportunity to use the skills I was expected to have when entering the professional world."

By the end of their senior year, the design teams are expected to have a tangible device in hand. If the project was funded by USU or federal grants, the project may go one step further and run through the USU Inventors Portal where a provisional patent is begun. Going through that process familiarizes the students with the many nuances of technology patenting.

Bringing in corporations with design needs adds yet another layer to the student's experience. Since the companies are local, the students are able to work closely with mentors from the company and build a professional relationship. Professionals from the company assist with student reviews and provide feedback on the project beginning with the design phase and going all the way through production.

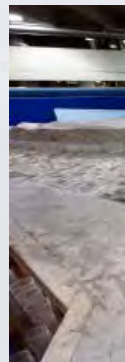
"Working with Utah companies is invaluable to us," Nielson said. "It allows our MAE program to become better known throughout the state and really broadens our exposure as we aren't limiting ourselves to any one industry. It also helps our students with job placement and helps our program to be more competitive with recruitment in the state."



The Lake Isabella Dam model at the USU Utah Water Research Laboratory with the new labyrinth weir spillway design.

Changing How Utah  
*(and the rest of the world)*

**MOVES  
WATER**



From above it looks like an accordion, but, in actuality, the labyrinth weir serves to be one of the most innovative dam refurbishment designs in the world. The Utah State University Water Research Lab-based design is being implemented in projects from Ferron, Utah, to California to Europe and is quickly becoming the go-to revamp for aging dam structures.

The weir idea is not a new one as Paul Tullis, USU professor emeritus of civil and environmental engineering, published a ground-breaking paper on the labyrinth weir design during his tenure, the result of which was a surge in labyrinth weir design application interest, both in engineering practice and research. It also created opportunities for graduate students to conduct specific applied research about the weir. Since the original work, USU students have expanded and refined the labyrinth weir hydraulics knowledge base and its design data through a multitude of published papers.

As a result of climate change, changes in land use and improved flood flow data records, linear-weir spillways on many older dams do not have sufficient discharge capacity to accommodate designed flood flows. In many cases, insufficient spillway discharge capacity can be mitigated by replacing the spillway's traditional linear weir with a nonlinear labyrinth weir as the compact, accordion-like design may increase capacity without increasing the width of the spillway chute.

Blake Tullis, USU professor of civil and environmental engineering, and his team of graduate students have expand-

ed on the initial research that was done by his father, Paul, a generation ago, and developed it into a viable option for dam modification. Dr. Tullis views the design as a valuable and cost-effective flood mitigation tool.

"If the largest predicted flood happened to occur and there's not enough spillway capacity, there's a potential for dam failure," said Dr. Tullis. "The labyrinth weir design mitigates that threat."

The weir allows for greater discharge in a confined space because flow over a weir is proportional to its length and the accordion-shaped walls create a lot of weir length. A weir replacement retrofit is typically more cost effective than constructing a larger spillway for a dam.

Dr. Tullis has witnessed the impact the improved dam design has had in the engineering world, even close to home in Utah. One project using the weir design is in Ferron, Utah, for the spillway on the Millsite Dam.

An engineer for the Utah Division of Water Resources happened upon the dissertation of Dr. Tullis' doctorate student Brian Crookston that described labyrinth weirs and used it as the basis for the Millsite Dam spillway redesign. Dr. Tullis also conducted a laboratory-scale physical model at the USU Utah Water Research Laboratory to support the Millsite spillway re-design effort.

"It is very gratifying to see our students' published research being used by a practicing engineer and referenced by other researchers," said Dr. Tullis.

Currently Dr. Tullis is working with engineers from the U.S. Army Corps of Engineers Sacramento Dis-



Blake Tullis

trict's Isabella Dam Safety Modification Project team to implement the labyrinth weir design at the Isabella dam in Kern County, California.

"The Corps developed their design using our published research as a guideline, and now we are validating that design in the laboratory," said Dr. Tullis. "It is pretty rewarding to be changing engineering practice with our applied research at Utah State University."

Dr. Tullis has directed the building of a 1:45 scale model of the Lake Isabella dam at the Water Research Lab that is roughly one third the size of a football field.

The model involved a significant amount of effort to build; handwork, as well as heavy equipment, was used and it took more than eight weeks to construct. Dr. Tullis and his team went to great lengths to match the topography of the reservoir by using concrete, stone and metal framing to ensure the accuracy of test flow results. The model has one service spillway as well as the proposed emergency spillway that incorporates the weir modification.

"Isabella is a unique structure that required solutions that are outside of the handbook," said Dr. Tullis. "The







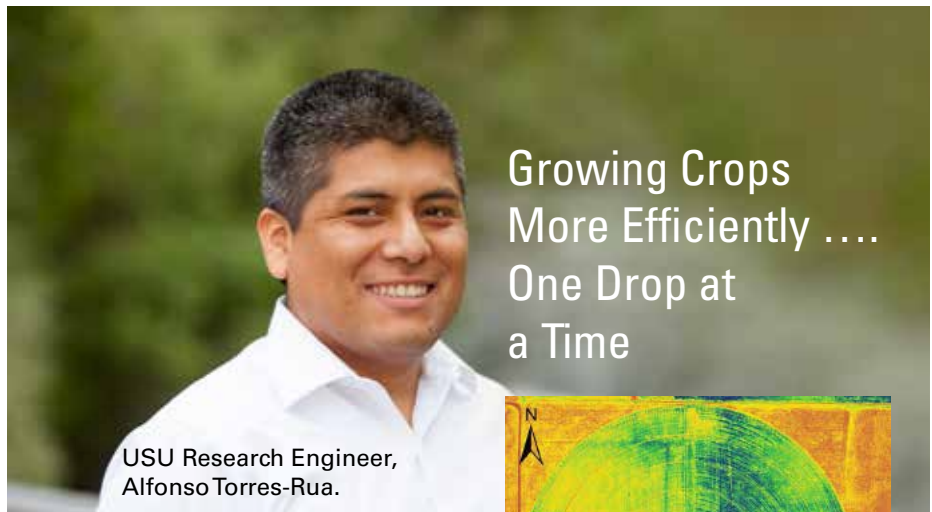
The Isabella model at the UWRL enables Dr. Tullis and his team to test and improve the design before construction begins.

model is an essential part of the Corps' pre-construction engineering and design phase and allows us to test the design and improve it before construction begins."

As a result of Dr. Tullis' work, he has become internationally known for his expertise with labyrinth weirs. At the 2013 International Workshop on Labyrinth and Piano Key Weirs in Paris, France, more than 60 percent of the presentations cited the work of Dr. Tullis and his students.

Dr. Tullis' graduate student Ricky Anderson's research on piano key weirs, a variation on the labyrinth design, was used as the design basis for the first piano key weir constructed in Switzerland at the Emmenau hydropower project.

It is through Dr. Tullis' work as well as his graduate students' work that the labyrinth weir design is impacting the engineering community not only within Utah but around the world. USU's Utah Water Research Lab provides the perfect environment for faculty and students to take risk, have an impact and change, for the better, the way we move water.



USU Research Engineer, Alfonso Torres-Rua.

## Growing Crops More Efficiently .... One Drop at a Time

Utah State University research engineer at the Utah Water Research Laboratory Alfonso Torres-Rua is changing water use in Utah's agriculture one drop at a time. His research is helping Utah farmers grow their crops more efficiently and with greater yields by providing them with actionable information to make data-based decisions about water management.

"Farmers in Utah have historically relied on their own experience or neighbors to make decisions about irrigation and fertilizer use," said Torres-Rua. "I hope that my research can affect that methodology and give farmers easily understood, real-time data for each of their fields on which to base their decisions while conserving water and increasing their yields."

Until recently, there has been little incentive to change agricultural technologies due to the high cost. Crops in Utah tend to be low-value crops like alfalfa that have a very thin profit margin. Farmers, some holding down a second job already, do not have extra capital to invest in large-scale projects.

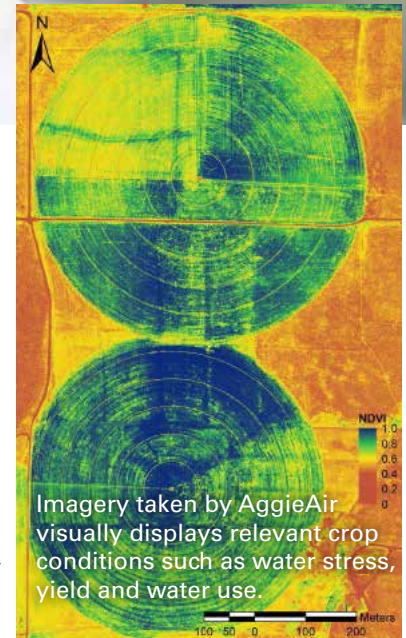
Torres-Rua is hoping to help farmers by employing the use of LandSat, a NASA satellite program, and an unmanned aircraft from USU, AggieAir, both of which collect data using visible, near-infrared and thermal cameras. The satellite and aircraft fly over multiple fields and map and measure crop conditions such as water stress, yield and water use. These crop conditions are placed on a Google Map website that displays the results in an actionable format for farmers and irrigators. The crop conditions for each farm are updated every eight days and the information is free for the users.

Farmers are encouraged to visit Torres-Rua's website and, based on their specific fields' data, are then able to adjust their water and fertilizer use on a micro-scale. The outcome is less and more precise water use and higher yields.

While the website and algorithms are easy to operate and cost little to maintain, the initial customization of the types of actionable information preferred by the farmers (water, fertilizers, soil moisture, etc., along with the initial data collection) take some investment which Torres-Rua hopes will be absorbed by the USDA and other federal agencies.

"My goal is to improve farm management by providing valuable information at a low cost," said Torres-Rua. "The savings in water, time and fertilizer use should more than make up for the technological investment."

Torres-Rua continues working to scale up the technology so it is used not just in Utah but anywhere there are irrigation and crop management issues around the world.



Imagery taken by AggieAir visually displays relevant crop conditions such as water stress, yield and water use.

## Working Together and Sharing Results

Jeff Horsburgh is using his data management skills to make the lives of engineering and hydrology researchers easier. He is an engineer by trade but works in what he calls the “grey zone” that exists between engineering and computer science.

Dr. Horsburgh is tackling the large task of collecting hydrology and water quality data from monitoring sites all over the state and building cyberinfrastructure systems to manage those data. In situ stream monitoring sites gather an enormous amount of data that is critical for managing water resources, but is too much for one person or even normal software tools to handle. Dr. Horsburgh’s cyberinfrastructure development aims to not only manage the plethora of data but is also enabling researchers across the state to work together, share results and catalog existing data resources and environmental sensing networks.

Dr. Horsburgh and colleagues at Brigham Young University and the University of Utah developed an innovative new hydroinformatics class aimed at better preparing graduate students at all three universities to collect and process the ever-increasing pool of hydrological data. He has been integrally involved in the past year with building new sensor networks in the Logan River, Red Butte Creek and Provo River watersheds

that are collecting data to study the sustainability of Utah’s water resources. Horsburgh is also playing a major role in the development of “HydroServer,” open-source software funded by the National Science Foundation that enables researchers all over the country to collect and manage streaming sensor data.

Dr. Horsburgh is hoping to grow the area of hydroinformatics at USU and continue to not only train engineers in the emerging field but also incorporate computer science students.

“The collection, manipulation, analysis and dissemination of big data are essential parts of the future of engineering and hydrology research,” said Dr. Horsburgh. “Our work is setting a solid foundation upon which future research and water management decision making can be based.”



USU Assistant Professor Jeff Horsburgh

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## Diving In to Keep Park City’s Water Clean

Park City, Utah is best known for its beautiful scenery and world class ski resorts. In 2007 and 2010 the mountain town had drinking water issues. Those episodes of discolored water have prompted water managers there to seek ways to deal with the past problem and provide high-quality water to its citizens.

USU faculty Laurie McNeill, David Stevens and Joan McLean and graduate students Willie Kent and Tiana Hammer are working with Park City water managers and Confluence Engineering to assess the cause of these adverse water quality events and develop techniques to respond to changes in the water system.

Professor McNeill’s team first assessed the water issues by setting up 14 monitoring sites and collecting over 80 data parameters for each of the locations over the course of one year. They used a hydroinformatics database designed at the Utah Water Research Laboratory (UWRL) to assemble the data and developed an interface for analyzing and visualizing the results.

In addition to the field data collection, Willie Kent performed controlled experiments at the UWRL to identify

biofilms that grow in the water pipes while Tiana Hammer’s experiments examined desorption of metals from the scale built up inside the pipes. Though traces of arsenic, thallium, manganese and iron were found in the water supply, Professor McNeill’s team wanted to identify all possible contaminants.

The team, in cooperation with the consulting firm, tested three different pipe cleaning techniques: unidirectional flushing (UDF) of high-velocity water through the system, stuffing large sponges through the pipes and “ice pigging,” a method where a slush-like salt solution using the city’s water supply flows through the system under normal operating conditions.

The sponges produced highly visible results going from light to a dark shade then back to light again once the pipe was clean and the contaminants were removed. The “ice-pigging” was equally successful based on visual observations and analytical results to date. High velocity UDF has been utilized by the city for several years. The samples were visually clear, and some analytical results showed reduction of metals, but

lesser so than the other techniques. Park City will be evaluating whether to use a combination of the tested methodologies or continue to utilize high velocity UDF only as they manage the system.

Professor McNeill is proud of the contributions her USU team has made toward evaluating and aiding Park City in decreasing the potential for future water challenges. The expertise of USU’s water researchers is making a big and important impact in the daily lives of Park City’s residents.







*Alumni Highlight:*  
*Ron Jibson*  
**Aggies are  
Making an  
Impact**

For College of Engineering alumnus Ron Jibson, it's easy to see the impact the college and Utah State University are making around the state.

"I work and associate with Aggies from all over the state — key business leaders and government leaders who are making the decisions looking toward Utah's future," said Mr. Jibson.

As the chairman, president and CEO of Questar Corporation, Mr. Jibson plays a part in making the decisions that impact Utah as it moves forward to the future. He sees the value the state puts on educating engineering students and said that often, when a student receives an education in Utah, they end up wanting to stay in Utah.

"Local companies looking to hire qualified engineers are able to hire within the state," said Mr. Jibson. "This benefits both the companies and Utah's economy."

During his 33 years with Questar, Mr. Jibson has had the opportunity to hire Aggie engineers and said they come with the "whole package."

"They are not only good engineers, but good communicators, who have received a well-rounded education," he said.

Mr. Jibson takes great pride in being an alum of the College of Engineering and said the administration on down to the faculty and staff genuinely care about the students and are great examples of what a college should be.

"The engagement between the students and faculty is

phenomenal," he said. "The professors have so much real-world knowledge and the students are able to benefit from that experience."

Reflecting back to his time on the USU campus, Mr. Jibson said his success in his career and in life is directly attributed to the university.

"Doors opened for me because of the degree I earned from Utah State University," he said.

As an alumnus, Mr. Jibson feels it is important to give back and stay involved with the place that gave him the foundation to succeed.

"It is important to sustain good things," he said. "If we look back, our success is shaped by others. Education is expensive and without some financial help, I would never have been able to graduate. Giving back or volunteering, no matter the level, gives others the opportunity to earn a good education and succeed."

And Mr. Jibson not only talks about giving back and volunteering at USU, he is an active participant at all levels. He currently serves as chair of the USU Board of Trustees and is on the USU Athletics stadium expansion steering committee. In the past, he has served on the College of Engineering Advisory Board. In 2003, he received the College of Engineering's Distinguished Alumnus Award, an award he said he was honored to receive, noting his father had received the same accolade many years earlier. Mr. Jibson and his wife, Janet,

have established endowed scholarships in the College of Engineering and contribute to the Merlin Olsen Excellence fund.

"Utah State is a great place to go to school," Mr. Jibson said. "The College of Engineering is represented very well nationally in many student competitions. Students will get a superb education and will have fun. You can't beat the USU experience."

After graduating from USU with a degree in civil engineering in 1978, Mr. Jibson later received an MBA from Westminster.

Mr. Jibson has served as Questar's president and chief executive officer and as a director since June 2010. He was appointed chairman of the board July 1, 2012. He is also president and CEO of Questar subsidiaries Wexpro Company and Questar Gas Company and is chairman of Questar Pipeline Company.

Mr. Jibson has significant industry involvement, serving as past chairman of the board of directors of the American Gas Association. He is past chair of Western Energy Institute, and also serves on the board of Gas Technology Institute. Mr. Jibson chairs the Salt Lake Chamber Board of Governors and serves on the board of IDACORP and its subsidiary, Idaho

Power Company, a regulated electric utility, and serves on the board of National Fuel Gas, an integrated energy company.

Mr. and Mrs. Jibson have three sons and eight grandchildren. His hobbies include golf, fly fishing, hunting and spending time with family.



James Ulwick pictured with his beloved wife, Dorothy.

## Losing a Pioneer of the USU Space Program, James C. Ulwick

Utah State University College of Engineering emeritus professor James C. Ulwick passed away in Winchester, Mass., on April 17, 2014. He was a month shy of his 90th birthday.

In 1980, Dr. Ulwick was appointed as professor in the Electrical Engineering Department and was co-appointed as chief scientist of the Space Dynamics Laboratory (SDL). In 1996, Dr. Ulwick's professorial appointment was in the renamed Department of Electrical and Computer Engineering and his title at SDL became director of the Science Division. He retired to emeritus status at the age of 82.

Dr. Ulwick's close association with the Utah space program began with the launch of a University of Utah Upper Air Research Project ionospheric payload aboard an Aerobee sounding rocket at Holloman Air Force Base in southern New Mexico. The next several years would see Dr. Ulwick involved with more than 400 space measurement missions over five decades. Space vehicle firings, under Dr. Ulwick's and USU colleague Kay Baker's leadership, were conducted at numerous locations around the globe, including Alaska, Canada, Norway, Sweden, New Mexico and Florida.

## A Message from the Executive Director of Development

University development is the work of putting those who have a desire to help in touch with the opportunities and needs in the College of Engineering at Utah State University. These opportunities can be anything from donating funds to supporting student scholarships, funding faculty research, helping with new building projects, sponsoring student projects and competitions and many other needs that, in the end, create better educational experiences for our students.

I recently had the opportunity to assist one of our engineering alumni set up a scholarship endowment in the college. I have known this alumnus for nearly 10 years, and when I first met him he was making annual contributions to the college that went toward general scholarships. His contributions were small, but showed that he cared for USU and wanted to help with the educational needs of our students. His contributions increased over the years until he told me that he'd like to set up a scholarship endowment in his and his wife's names. He wanted to create a fund that would grow and provide scholarship help year after year. I was impressed with his generous attitude, but, more importantly, I was happy to see how his, and other donations, have made such a great impact on the lives of our engineering students.

This past school year I was able to see hundreds of engineering students receive scholarships to help fund their education at Utah State University. These scholarships allow our engineering students assistance with their tuition and educational expenses and give them more time to focus on their studies. In many cases scholarship assistance provides students the opportunity to get their college degree much quicker and with less debt. I'm happy to say that these scholarship opportunities are growing each year with the expanding scholarship and graduate fellowship endowments here in the College of Engineering.

Working with engineering students at USU has been a privilege, and I'm happy to be involved in helping create successful engineers. As alumni and friends of the USU College of Engineering, I thank you for all you do and all you have done to help build this institution and encourage those who study and work here.

Please contact me with any questions you have about the College of Engineering.

Sincerely,

Val Potter  
Executive Director of Development  
College of Engineering



# UtahState UNIVERSITY

## COLLEGE OF ENGINEERING

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